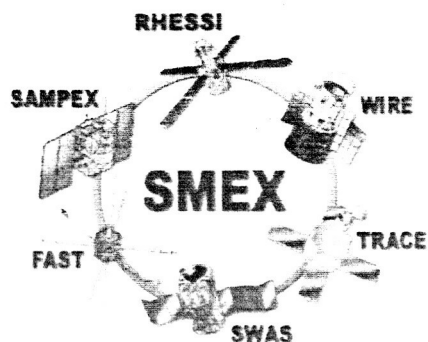


# Implementation of a Middleware Based Ground System

March 2, 2005, GSAW2005 Conference



**Presented By**

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**Teammates**

NASA – GMSEC

NASA – SSMO

Honeywell Technology Solutions, Inc.

L-3 Storm Control Systems



## NASA's Small Explorers



### SMEX Program

- Provide frequent flight opportunities
- Inexpensive and well-focused science missions
- Cost cap at \$120 million
- First program to use "Faster, Better, Cheaper"

### SMEX Satellite Characteristics

- Weigh between 180 and 250 kg
- Consume between 50 and 200 watts

Mission	Operations Center
SAMPEX	Bowie State University
FAST	UC, Berkeley
SWAS	NASA, GSFC
TRACE	NASA, GSFC
WIRE	Bowie State University
RHESSI	UC, Berkeley

## Current SMEX Missions



Satellite	Launch Date	Service	Mass	Orbit	Passes
SAMPEX	July 3, 1992	3 yrs.	157 kg	550 km x 675 km, 82°	2
FAST	August 21, 1996	1 yr.	191 kg	351 km x 4175 km, 83°	10-12
TRACE	April 1, 1998	1 yr.	250 kg	600 km x 650 km, 97.80°	4-6
SWAS	December 5, 1998	2 yrs.	288 kg	637 km x 653 km, 69.90°	2
WIRE	March 3, 1999	4 mo.	258.7 kg	540 km x 590 km, 97.56°	2
RHESSI	May 5, 2002	3 yrs.	304 kg	587 km x 600 km, 38°	6 - 9

All missions are still active today!

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## Why Reengineer?



Demonstrate Fleet Operations For Future Missions with Reduced Risk

Infuse New Mission Services Technol



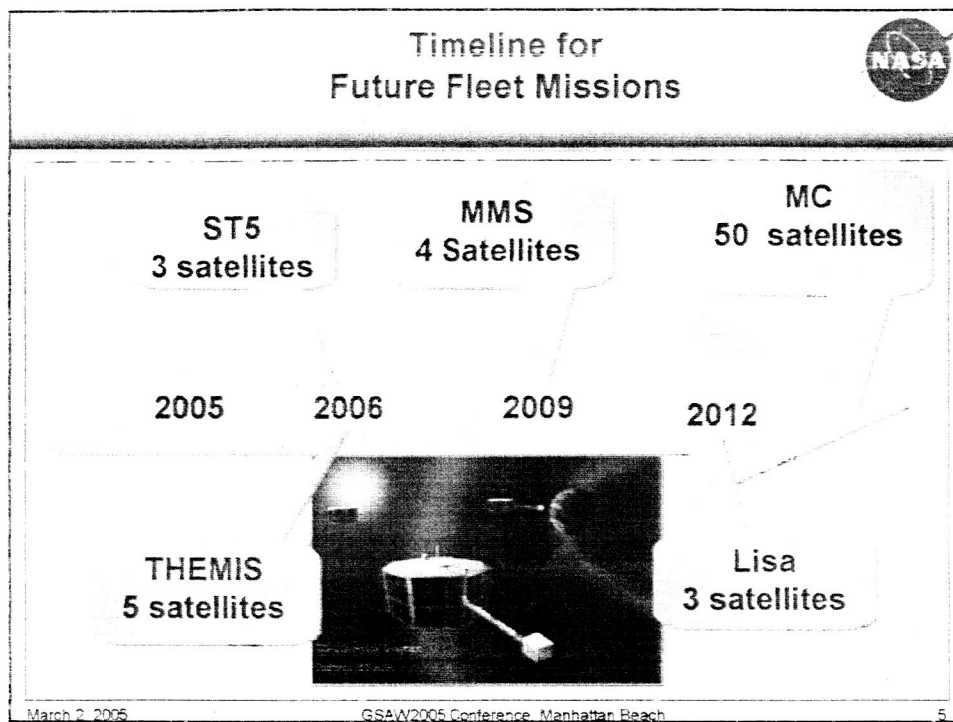
Demonstrate Potential for Mission Operations Cost Reductions

Continued Value-Added Research from On-Orbit Assets


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### New Mission Services Technologies



#### GSFC Mission Services Evolution Center (GMSEC)

- Provides message-based communication services using commercial middleware
  - Publish / subscribe
  - point-to-point
  - file transfer
- Makes it much easier to add new tools, reduce integration efforts
- Standardized application interfaces to the middleware
- Standardized ground system messages
  - Telemetry and commanding,
  - Logs and archives
  - Products (flight dynamics, scheduling, etc...)



GMSEC  
Goddard Space Flight Center  
NASA

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## Demonstrate Mission Cost Reductions



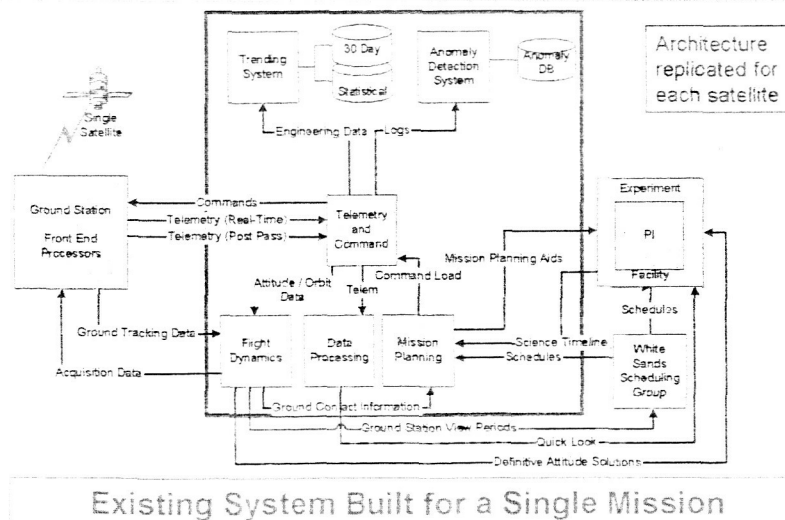
- Consolidation of Hardware and Software to Support Heterogeneous Fleets
- Extend Automation Capabilities to Provide Lights-Out Operations Beyond Current Capabilities
- Distributed Operations Between NASA and Universities

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## Previous SMEX MOC Architecture

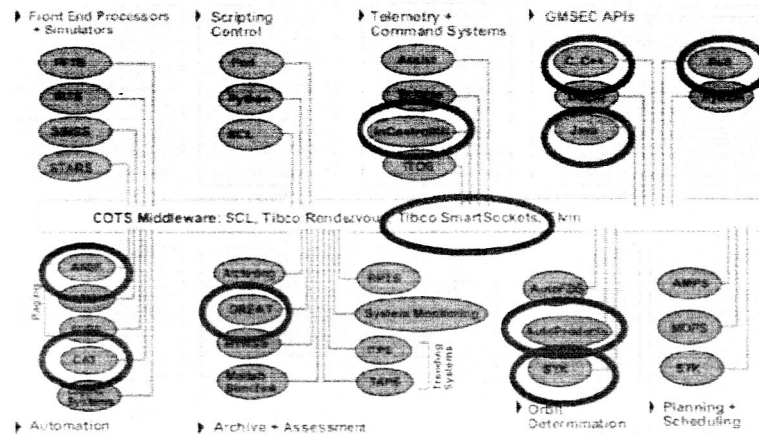


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# SMEX Component Selection

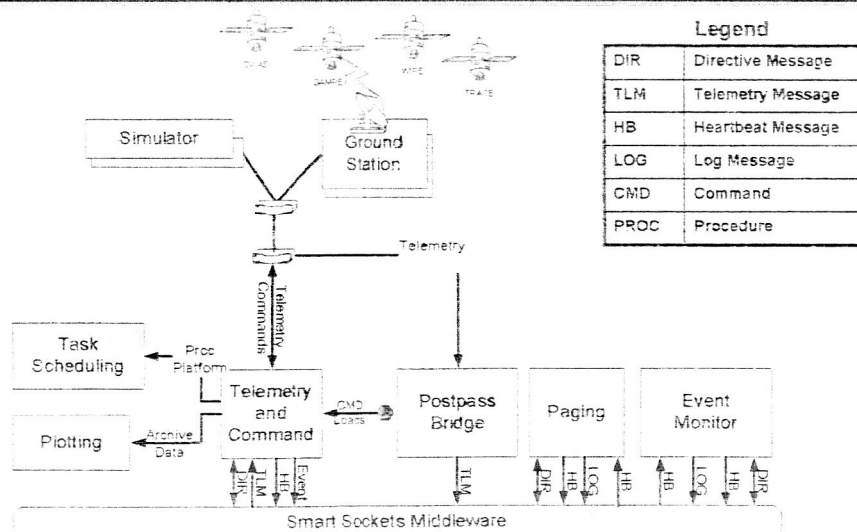


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# Real-time Architecture

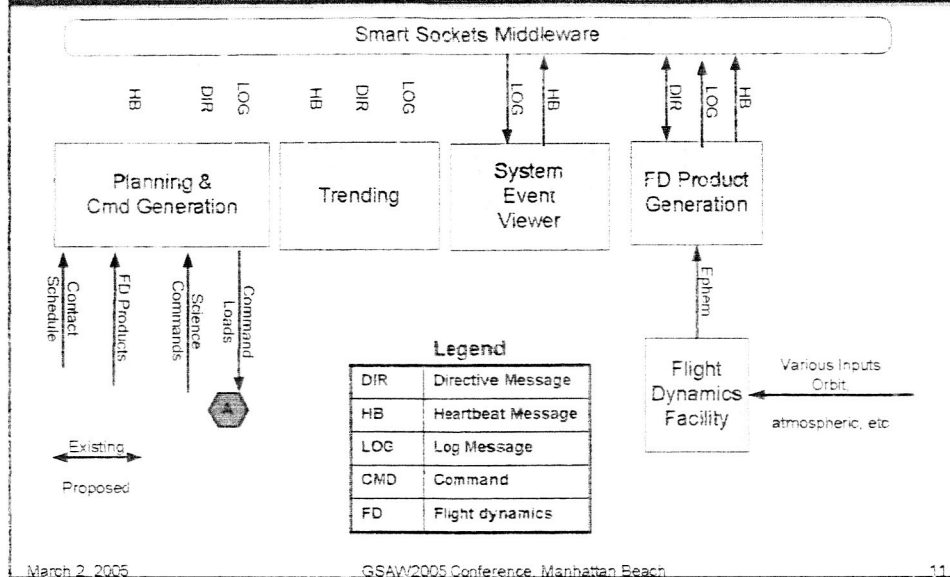


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## Offline Architecture



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## Lessons Learned



- Reduces Integration Time
- Component Updates Don't Impact Entire System
- Use of Small Independent Components for New Functions
- Potential for Further Integration
  - Ground Stations to MOC
  - MOC to Experiment Facilities
  - Scheduling Facilities to MOC

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## SMEX Direction in 2005



### Advanced Automation

- Routine Operations
- Operators Alerted to Anomalies
- Automatic Pass Scheduling



### Demonstrate Two Weeks Pass Automation

### Explore Integration of Other Missions

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## Additional Information



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## Acronyms



ANSR	Alert Notification System Router
CAT	Criteria Action Table
CMS	Command Management System
DPS	Data Processing System
FAST	Fast Auroral Snapshot Explorer
GMSEC	GSFC Mission Services Evolution Center
LISA	Laser Interferometer Space Antenna
PI	Principal Investigator
MC	Magnetospheric Constellation
MMS	Magnetospheric Multiscale Mission
RHESSI	Reuven Ramaty High Energy Solar Spectroscopic Imager
SAMPEX	Solar Anomalous and Magnetospheric Particle Explorer
SMEX	Small Explorer
ST5	Space Technology 5
SWAS	Submillimeter Wave Astronomy Satellite
T&C	Telemetry and Command
TRACE	Transition Region and Coronal Explorer
WIRE	Wide-Field Infrared Explorer